May 11, 1965 H. A. IMHOF 3,182,926

STRAND GUIDING DEVICES

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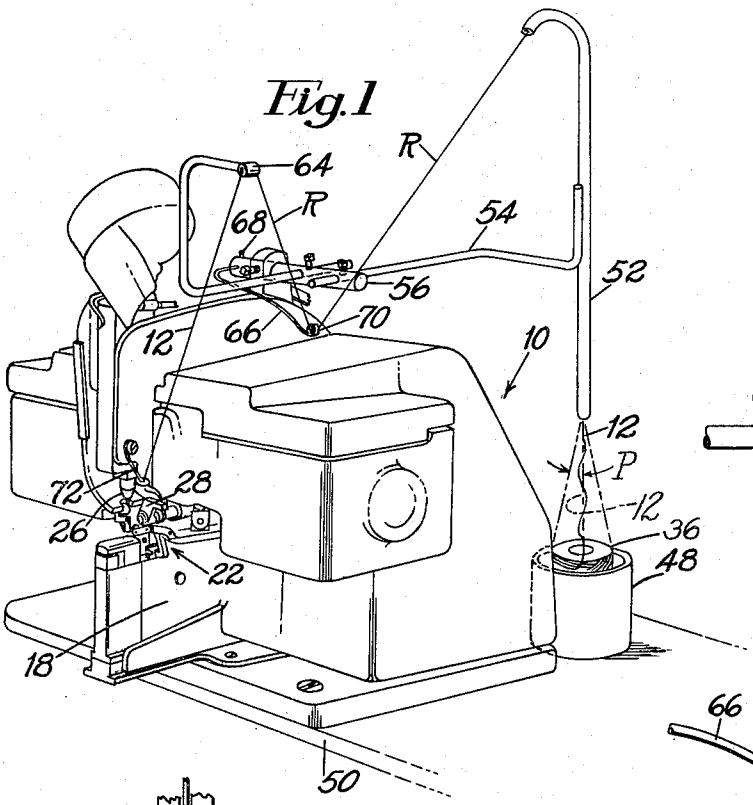
Fig. 1



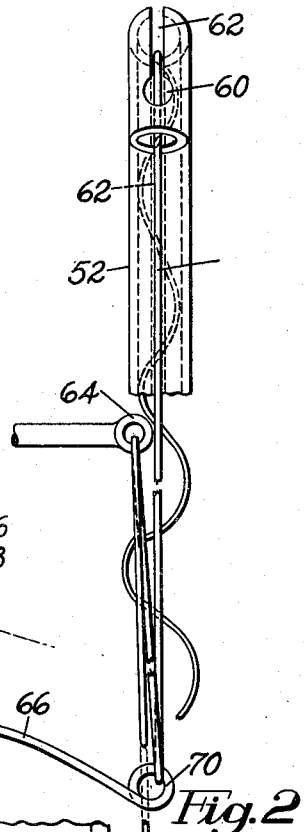


Fig. 2

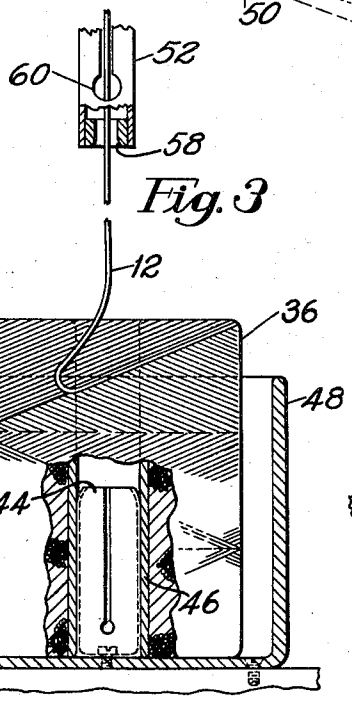
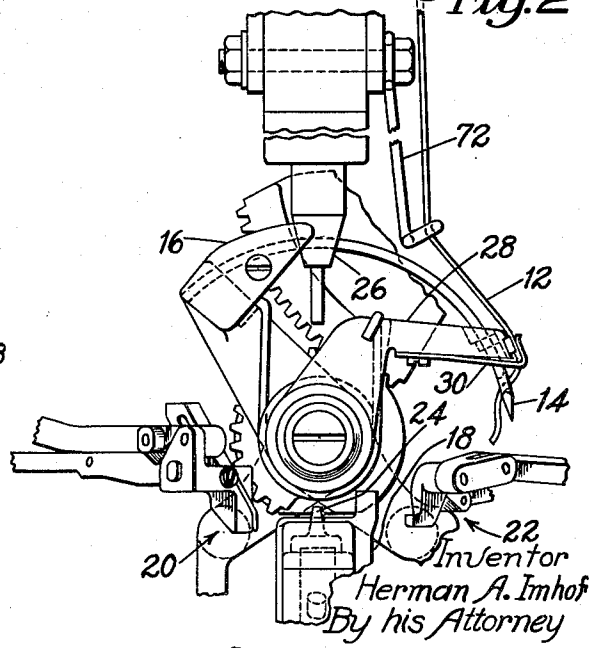


Fig. 3



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STRAND GUIDING DEVICES

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Fig. 4

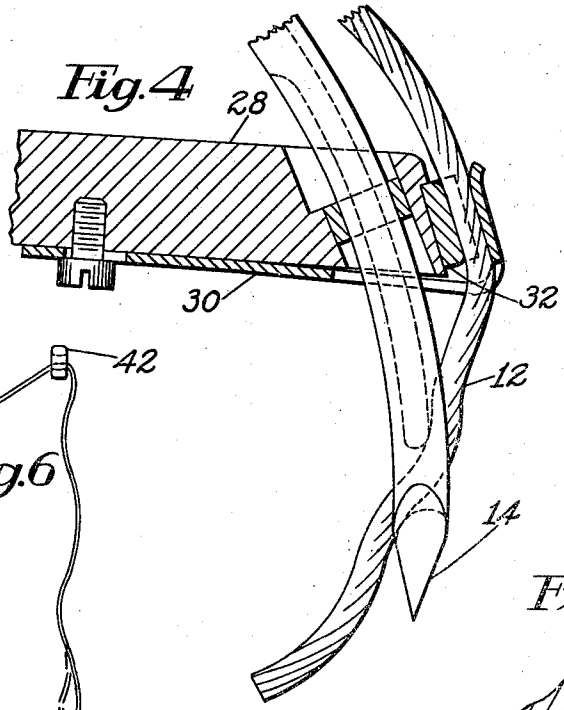


Fig. 5

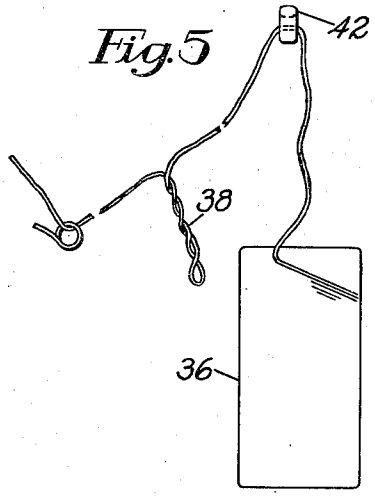


Fig. 6

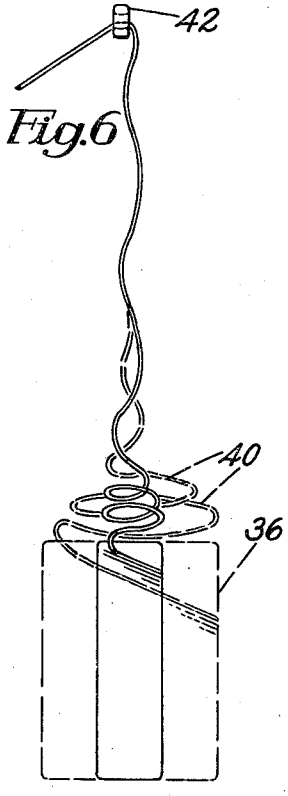


Fig. 7

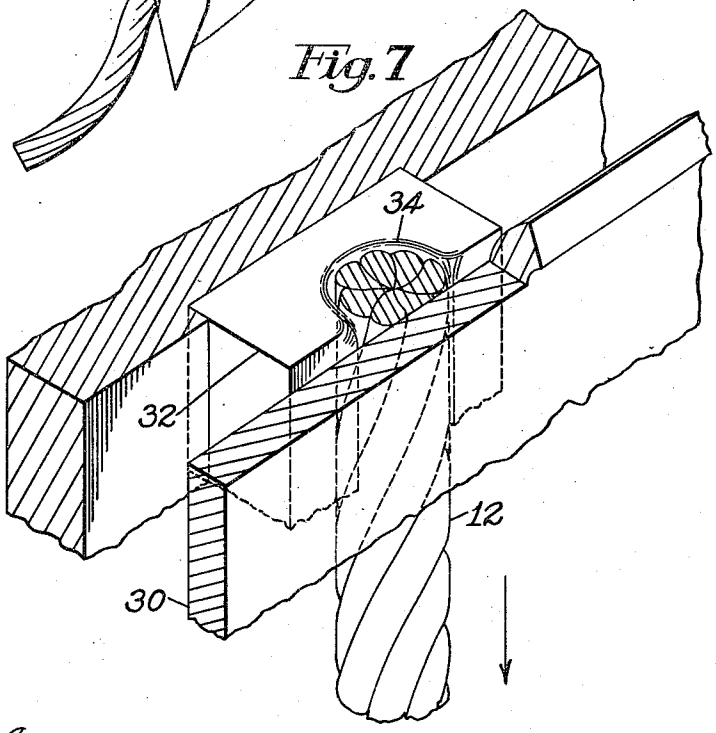
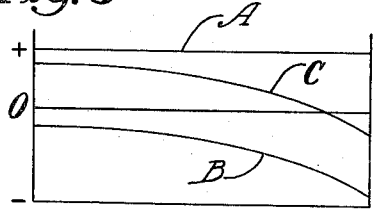


Fig. 8



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3,182,926

STRAND GUIDING DEVICES

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3 Claims. (Cl. 242—157)

The present invention relates to strand guiding devices adapted to prevent the formation of obstructions in strands being drawn to strand consuming machines.

The invention is illustrated herein in association with an article stringing machine of the type disclosed in United States application Serial No. 117,219, filed June 15, 1961, now Patent No. 3,142,896, in the names of Charles P. Cardani et al., and particularly such a machine additionally including strand controlling devices disclosed in my copending application Serial No. 184,804, filed April 3, 1962.

Certain characteristics of twisted multi-ply strands tightly wound in generally cylindrical packages tend to cause difficulties when the strand is drawn intermittently through frictional control devices. One of these characteristics is the tendency of slack portions of strand in which the normal set twist has been disturbed, to "pigtail," a term describing the twisting of the thread upon itself. The second objectionable characteristic of strands is that of coil memory, the tendency of each turn as it unwinds from the package or cop to retain its coil shape. Under slack strand conditions, such free floating coils tend to interlock. Either interlocked coils or pigtails present obstructions to the free flow of the strand through guides and control devices so that as a result, the needle is frequently unthreaded causing stoppages and production delays.

In machines in which it is possible either to anchor the strand mechanically or to hold it manually at the beginning of a strand consuming operation, the effects of the charactersitics already described are avoided by mounting the supply cop on a rotatable support and adding brakes, tensions and other control devices between the supply and the strand consuming instrumentalities of the machine. Such arrangements, however, are inapplicable to machines such as that of my copending application, which operate interruptedly a single cycle at a time and in which the leading end of the strand is carried through the work piece by the combined friction of a needle eye and that of a unidirectional friction device cooperatively associated with the needle. In a stringing machine, particularly when drawing as much as 18 inches of strand in a period of approximately ¼ second, acceleration and decceleration further complicate the problems of strand control.

It is accordingly an object of the present invention to provide strand guidance without the formation of obstructions to the free flow of the strand originating from the passage of the strand through devices which disturb its normal twist.

A further object is to avoid the interlocking or tangling of adjacent coils after being unwound from a generally cylindrical strand package or cop.

A more particular object is to compensate for the disturbance in strand twist by the opposite effect of unwinding from the cop.

Still another object is to provide for the storage of disturbances in strand twist without ill effects at the beginning of the utilization of a strand from a package so that it can be compensated for after a part of the package has been consumed.

In the achievement of the foregoing objects a stationary support is provided for the strand package and according to a feature of the invention an elongated tubular member is mounted generally in alinement with the axis

of the package to provide for the strand a control passage which prevents the formation of coils. In addition, the tendency of the strand to coil applies a gentle friction inside the tube to cooperate with other control instrumentalities.

The tube is slit longitudinally for ease in threading and is preferably cane-shaped or in the form of an inverted J. Cooperating with the tubular member, according to another feature of the invention, is a guide eye positioned in spaced relationship with the tubular member and providing a controlled length which is maintained under light tension. For this purpose an automatic take-up in the form of a light weight spring guide is interposed along the path of the strand between the tubular member and the guide eye. When a substantial length of strand is required in a brief time interval, the automatic take-up yields the requirement and maintains the tension while more gradually regaining the yielded strand from the supply.

The objects and features of the invention will be more fully appreciated from a detailed description of an illustrative embodiment taken in connection with the accompanying drawings, in which

FIG. 1 is a view in perspective of an article stringing machine, such as that of my copending application, to which have been added strand control devices in accordance with the present invention;

FIG. 2 is a fragmentary view of a portion of the machine in front elevation also showing the path of the strand through the control devices of FIG. 1;

FIG. 3 is a detail view of a strand supply supporting device in which is also illustrated the relationship with the strand supply of a part of a tubular guide member;

FIG. 4 is a fragmentary view of an article stringing machine showing a needle and a friction mounted on a needle guide associated with the needle;

FIGS. 5 and 6 are schematic illustrations of defects occurring in the strand, without the control devices of the present invention;

FIG. 7 is a fragmentary view on a greatly enlarged scale illustrating the passage of a strand through the friction of FIG. 4; and

FIG. 8 is a graphical representation of rates of twist disturbance and correction in a strand being guided by devices according to the present invention.

Referring particularly to FIGS. 1, 2 and 4, the behavior of the strand will be appreciated from a brief description of strand manipulating and control instrumentalities of an artcile stringing machine indicated generally at **10**. The article stringing machine is employed for passing the leading end of a strand **12** through either a single article or a pair of articles and then forming from the strand a closed loop, the ends of which are secured together by means of an eyelet. For this purpose the article stringing machine includes a curved eye pointed needle **14** oscillated by a needle segment **16** to penetrate a pair of articles clamped against a post **18**. The strand is manipulated by a pair of pincers indicated at **20** and **22** after that portion of the strand passing through the article has been severed from the supply. The pincers **20** and **22** form bights about an eyelet spindle **24** mounted on the post **18** and the two ends of the closed loop are connected together by means of an eyelet clinched on the spindle **24** by an eyeleting tool **26**.

Associated with the needle to prevent its excessive deflection while penetrating resistive materials is a needle guide **28** upon which is supported a strand-entraining friction **30** described in detail in my above-identified copending application. In the present machine the operation of the friction **30** performs essentially the same function as in the machine of my application but its durability has been enhanced by the addition of wear resistant guide block **32** formed with a guide through **34**.

As shown particularly in FIG. 7, a type of strand which has been found highly satisfactory both from the point of view of necessary tensile strength and price consists of seven substrands or cords of cotton, linen, or of a synthetic fiber such as nylon. The strand 12 depicted in FIG. 7 is a left hand twist, corresponding to a right hand helix, according to terminology employed in the thread and cord industry.

In passing from the supply package which is in the form of a cop 36, through the trough 34 and into contact with the friction 30, the line of demarcation between adjacent substrands or cords of the strand tend to remain flat against the friction with the result that an added twist is imparted to that portion of the strand between the block 32 and the supply. This tendency of the strand 12 to rotate under the friction 30 causes the formation of pigtails such as that shown at 38 in FIG. 5. The apparatus according to the present invention prevents the formation of these pigtails which occur when a length of strand has its normal set twist disturbed either additively or subtractively while the strand is slack.

Another defect to which the present invention is directed is that caused by memory as illustrated in FIG. 6. The term "memory" as here employed, refers to the property of a strand which causes it to retain the shape of a coil obtained from being coiled for extended periods in the strand package rather than assuming a straight line position in coming off the strand package. As shown by the dash line illustration of FIG. 6, coils 40 coming off the cop 36 and especially when the cop is of maximum size, tend to tangle and thus form an obstruction to the flow of the strand through such guiding instruments as an eye 42.

The apparatus, according to the present invention, takes advantage of the combination of defects evidenced in the packaged strands to cause one to cancel the other. Cooperating with the present apparatus is a support for the cop 36 in the form of a spring stud 44 engaging the inside diameter of a tube 46 upon which the cop is wound. The stud 44 is fixedly supported at the center of a bowl 48 secured to the top of a bench 50 upon which the machine 10 is also supported.

Along the path of the thread, the first controlling element is an inverted J-shaped elongated tube 52 fixed to a horizontal supporting arm 54 which is adjustable in a horizontal bracket 56 to position the straight portion of the tube concentrically with the cop 36. At its lower end the tube 52 is provided with a wear resistant bushing 58 having an ample lead-in radius for preventing the formation of a sharp edge on the tube which would tend to abrade the strand. For convenience in threading, the tube is perforated at 60 and is additionally formed with a longitudinal slot 62 running practically the whole length of the tube. Also mounted on the bracket 56 is an adjustable fixed eye 64 mounted in spaced relationship with the exit end of tube 52 to provide between the eye and the tube a length of strand identified by the character R in FIG. 1, which serves as a counterweight for the vertically arranged portion of strand within the tube 52 and also presents a standing, ready supply of strand to meet the sudden demands of the stringing machine 10. Acting on the portion R of the strand is an automatic takeup 66 in the form of a long, lazy cantilever spring anchored by a set screw 68 on the bracket 56 and formed at its distal end with an eye 70. From the fixed eye 64 the strand passes to a wire guide eye 72 fixedly supported on the frame of the machine 10 in position to aline the strand 12 with the trough 34 in the guide block 32 lying in the plane of the needle 14.

The positioning of the lower end of the tube 52 has been found to be somewhat critical in order to obtain optimum results. From the point of view of preventing the uncontrolled formation of coils 40 described in relation with FIG. 6, the lower end of the tube 52 is best placed as close as possible to the upper end of the cop

36. However, when the spacing from the lower end of the tube 52 to the cop is too close it has been found that there is a tendency for the strand to snag on the upper edge of the cop in the process of unwinding. This tendency is especially pronounced when the cop is of maximum size and the strand is either irregularly surfaced or rough textured. It has been found, however, that as shown in FIG. 1, a payout angle P of approximately 15° works well with strands having the most adverse payout flow properties. The payout angle P is one having its apex on the common axis of the tube 52 and of the cop 36 at the lower end of the tube, the angle P being defined between the axis of the cop 36 and the line connecting the apex with the upper periphery of a cop of maximum diameter.

In the operation of the machine, when the strand measuring instrumentalities are adjusted to provide a maximum separation between interconnected articles or maximum loop size in a single article, as explained in detail in the above-identified copending applications, the stringing machine 10 draws as much as 18" of strand from the supply during a period of approximately one quarter of a second. Under such conditions the inertia of the strand causes only a part of the strand requirements of the machine to be fulfilled directly from the supply and at the same time the portion R of the strand is appreciably shortened as the eye 70 of the automatic takeup rises several inches above the position depicted in FIG. 1. The eye 70 resumes its normal position gradually after the strand requirements of the machine have been fulfilled. Providing resistance against which the automatic takeup is operating is not only the weight of the vertical portion of the strand within the tube 52 but also a light friction, stemming from the coil memory of the strand which causes the undulating strand frictionally to engage the inner wall of the tube.

The passage of the strand 12 between the block 32 and the friction 30 causes the strand to be additively twisted between the friction and the supply as has already been indicated. Because the contact of the strand is with a relatively broad surface rather than with a form entering deeply into the intersection between adjacent substrands only a part of the turns of twist in the strand is imparted as additive twist. The amount of such additive twist varies with the amount of set twist in the strand, the material of which the strand is made, the tightness of the twist, the sharpness of delineations between substrands, the pressure of the friction 30 upon the strand and the area of contact between the strand and the friction 30. While the amount of twist thus added to the strand is difficult to predict because of the widely varying parameters, it has been found that twist is thus added at a relatively constant rate proportional to the length of strand drawn beneath the friction 30. This rate of addition of twist is represented in FIG. 8 by the graph A which remains at a constant level from left to right representing the time elapsed while a full cop is completely consumed.

The arrangement of guiding devices, according to the present invention, makes it possible to cancel out the additive twist described above by opposite or subtractive twist originating with the unwinding of the strand from the cop. Thus the left hand twist already defined, corresponding to a right hand helix, is canceled by placing the cop so that the strand will unwind in a counterclockwise direction as the cop is viewed from above. However, the rate of subtractive twist per unit length changes constantly, continuing to increase as the diameter of the cop is reduced from full to empty. Because the portion of strand which remains unconfined is kept under continuous light tension a considerable amount of additive twist which is not immediately canceled by the subtractive twist of unwinding when a strand supply cop is new may be tolerated. With a new cop of maximum diameter the rate of subtraction is less than the additive components and is depicted in FIG. 8 as the graph B. It is seen, however,

that as the consumption of the cop progresses and the diameter is reduced, the rate of subtraction, under optimum conditions at the friction, reaches a level substantially greater than the additive component and is thus capable not only of canceling out the then being produced additive component but also to subtract previously accumulated additive twist. The resultant of combining the additive effect from the friction **30** and the subtractive effect of unwinding from the cop is depicted as the graph C in FIG. 8 and under ordinary conditions the resultant rate either reaches or crosses the zero axis before the cop is fully consumed.

Having thus described my invention what I claim as new and desire to secure by Letters Patent of the United States is:

1. An article stringing machine for passing a flexible twisted strand such as a string from a fixedly supported wound supply package to an article including an element which disturbs the normal twist of the strand by adding twist to the length of strand between the supply package and the twist-disturbing element in combination with a tubular guide member mounted generally in alinement with the winding axis of the package and through which the strand passes while undulations in the strand cause the strand frictionally to engage the internal walls of the guide member, an eye spaced from the guide member, through which eye the strand also passes in advance of the machine, and yielding means between the guide member and the eye for maintaining the strand under continuous light tension to prevent the formation of obstructions in the additively twisted length of strand during periods when the strand is at rest because the machine does not require strand.

2. An article stringing machine for passing a flexible twisted strand such as a string from a fixedly supported wound supply package to an article including an element which disturbs the normal twist of the strand by adding twist to the length of strand between the supply package and the twist-disturbing element in combination with a guide means in the form of a tubular member mounted in alinement with the axis of the package and having an internal diameter frictionally engageable by undulations in the strand, an eye spaced from the tubular member through which the strand passes in advance of the machine, the length of strand between the guide member and the eye

providing a reservoir for supplying sudden strand requirements of the machine, and a light cantilever spring member bearing on the strand in the reservoir and adapted to yield for providing the strand requirements of the machine and to maintain the strand reservoir under continuous light tension when the strand is at rest to prevent the formation of obstructions in the strand.

3. An article stringing machine for passing a flexible twisted strand such as a string from a fixedly supported wound supply package to an article including an element which disturbs the normal twist of the strand by adding twist to the length of strand between the supply package and the twist-disturbing element in combination with mounting means for supporting the supply package in a position in which each unwinding turn generates a subtractive twist turn for canceling an additive turn inserted by the twist-disturbing element, a tubular guide member disposed generally in alinement with the winding axis of the package and through which the strand passes, an eye spaced from the guide member, through which eye the strand also passes, and yielding means bearing on the strand between the guide member and the eye to maintain that portion of the strand under continuous light tension while the strand is at rest and before the twist generated in unwinding has sufficiently reduced the additive twist to prevent the formation of obstructions.

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